**Gr. 9 Academic (MPM1D) – Overall Expectations**

Number Sense and Algebra

By the end of this course, students will:

• demonstrate an understanding of the exponent rules of multiplication and division, and apply them to simplify expressions;

• manipulate numerical and polynomial expressions, and solve first-degree equations.

Linear Relations

By the end of this course, students will:

• apply data-management techniques to investigate relationships between two variables;

• demonstrate an understanding of the characteristics of a linear relation;

• connect various representations of a linear relation.

Analytic Geometry

By the end of this course, students will:

• determine the relationship between the form of an equation and the shape of its graph with respect to linearity and non-linearity;

• determine, through investigation, the properties of the slope and *y*-intercept of a linear relation;

• solve problems involving linear relations.

Measurement and Geometry

By the end of this course, students will:

• determine, through investigation, the optimal values of various measurements;

• solve problems involving the measurements of two-dimensional shapes and the surface areas and volumes of three-dimensional figures;

• verify, through investigation facilitated by dynamic geometry software, geometric properties and relationships involving two-dimensional shapes, and apply the results to solving problems.

**Gr. 9 Applied (MFM1P) – Overall Expectations**

Number Sense and Algebra

By the end of this course, students will:

• solve problems involving proportional reasoning;

• simplify numerical and polynomial expressions in one variable, and solve simple first-degree equations.

Linear Relations

By the end of this course, students will:

• apply data-management techniques to investigate relationships between two variables;

• determine the characteristics of linear relations;

• demonstrate an understanding of constant rate of change and its connection to linear relations;

• connect various representations of a linear relation, and solve problems using the representations.

Measurement and Geometry

By the end of this course, students will:

• determine, through investigation, the optimal values of various measurements of rectangles;

• solve problems involving the measurements of two-dimensional shapes and the volumes of three-dimensional figures;

• determine, through investigation facilitated by dynamic geometry software, geometric properties and relationships involving two-dimensional shapes, and apply the results to solving problems.

**Gr. 10 Academic (MPM2D) – Overall Expectations**

Quadratic Relations of the form y = ax^2 + bx + c

By the end of this course, students will:

• determine the basic properties of quadratic relations;

• relate transformations of the graph of *y* = *x^*2 to the algebraic representation *y* = *a*(*x – h*)^2 *+ k*;

• solve quadratic equations and interpret the solutions with respect to the corresponding relations;

• solve problems involving quadratic relations.

Analytic Geometry

By the end of this course, students will:

• model and solve problems involving the intersection of two straight lines;

• solve problems using analytic geometry involving properties of lines and line segments;

• verify geometric properties of triangles and quadrilaterals, using analytic geometry.

Trigonometry

By the end of this course, students will:

• use their knowledge of ratio and proportion to investigate similar triangles and solve problems related to similarity;

• solve problems involving right triangles, using the primary trigonometric ratios and the Pythagorean theorem;

• solve problems involving acute triangles, using the sine law and the cosine law.

**Gr. 10 Applied – Overall Expectations**

Measurement and Trigonometry

By the end of this course, students will:

• use their knowledge of ratio and proportion to investigate similar triangles and solve problems related to similarity;

• solve problems involving right triangles, using the primary trigonometric ratios and the Pythagorean theorem;

• solve problems involving the surface areas and volumes of three-dimensional figures, and use the imperial and metric systems of measurement.

Modelling Linear Relations

By the end of this course, students will:

• manipulate and solve algebraic equations, as needed to solve problems;

• graph a line and write the equation of a line from given information;

• solve systems of two linear equations, and solve related problems that arise from realistic situations.

Quadratic Relations of the form y = ax^2 + bx + c

By the end of this course, students will:

• manipulate algebraic expressions, as needed to understand quadratic relations;

• identify characteristics of quadratic relations;

• solve problems by interpreting graphs of quadratic relations.

**Gr. 11 Functions (MCR3U) – Overall Expectations**

Characteristics of Functions

By the end of this course, students will:

**1.** demonstrate an understanding of functions, their representations, and their inverses, and make connections between the algebraic and graphical representations of functions using transformations;

**2.** determine the zeros and the maximum or minimum of a quadratic function, and solve problems involving quadratic functions, including problems arising from real-world applications;

**3.** demonstrate an understanding of equivalence as it relates to simplifying polynomial, radical, and rational expressions.

Exponential Functions

By the end of this course, students will:

**1.** evaluate powers with rational exponents, simplify expressions containing exponents, and describe properties of exponential functions represented in a variety of ways;

**2.** make connections between the numeric, graphical, and algebraic representations of exponential functions;

**3.** identify and represent exponential functions, and solve problems involving exponential functions, including problems arising from real-world applications.

Discrete Functions

By the end of this course, students will:

**1.** demonstrate an understanding of recursive sequences, represent recursive sequences in a variety of ways, and make connections to Pascal’s triangle;

**2.** demonstrate an understanding of the relationships involved in arithmetic and geometric sequences and series, and solve related problems;

**3.** make connections between sequences, series, and financial applications, and solve problems involving compound interest and ordinary annuities.

Trigonometric Functions

By the end of this course, students will:

**1.** determine the values of the trigonometric ratios for angles less than 360º; prove simple trigonometric identities; and solve problems using the primary trigonometric ratios, the sine law, and the cosine law;

**2.** demonstrate an understanding of periodic relationships and sinusoidal functions, and make connections between the numeric, graphical, and algebraic representations of sinusoidal functions;

**3.** identify and represent sinusoidal functions, and solve problems involving sinusoidal functions, including problems arising from real-world applications.

**Gr. 11 Functions and Applications (MCF3M) – Overall Expectations**

Quadratic Functions

By the end of this course, students will:

**1.** expand and simplify quadratic expressions, solve quadratic equations, and relate the roots of a quadratic equation to the corresponding graph;

**2.** demonstrate an understanding of functions, and make connections between the numeric, graphical, and algebraic representations of quadratic functions;

**3.** solve problems involving quadratic functions, including problems arising from real-world applications.

Exponential Functions

By the end of this course, students will:

**1.** simplify and evaluate numerical expressions involving exponents, and make connections between the numeric, graphical, and algebraic representations of exponential functions;

**2.** identify and represent exponential functions, and solve problems involving exponential functions, including problems arising from real-world applications;

**3.** demonstrate an understanding of compound interest and annuities, and solve related problems.

Trigonometric Functions

By the end of this course, students will:

**1.** solve problems involving trigonometry in acute triangles using the sine law and the cosine law, including problems arising from real-world applications;

**2.** demonstrate an understanding of periodic relationships and the sine function, and make connections between the numeric, graphical, and algebraic representations of sine functions;

**3.** identify and represent sine functions, and solve problems involving sine functions, including problems arising from real-world applications.

**Gr. 11 Foundations for College Math (MBF3C) – Overall Expectations**

Mathematical Models

By the end of this course, students will:

**1.** make connections between the numeric, graphical, and algebraic representations of quadratic relations, and use the connections to solve problems;

**2.** demonstrate an understanding of exponents, and make connections between the numeric, graphical, and algebraic representations of exponential relations;

**3.** describe and represent exponential relations, and solve problems involving exponential relations arising from real-world applications.

Personal Finance

By the end of this course, students will:

**1.** compare simple and compound interest, relate compound interest to exponential growth, and solve problems involving compound interest;

**2.** compare services available from financial institutions, and solve problems involving the cost of making purchases on credit;

**3.** interpret information about owning and operating a vehicle, and solve problems involving the associated costs.

Geometry and Trigonometry

By the end of this course, students will:

**1.** represent, in a variety of ways, two-dimensional shapes and three-dimensional figures arising from real-world applications, and solve design problems;

**2.** solve problems involving trigonometry in acute triangles using the sine law and the cosine law, including problems arising from real-world applications.

Data Management

By the end of this course, students will:

**1.** solve problems involving one-variable data by collecting, organizing, analysing, and evaluating data;

**2.** determine and represent probability, and identify and interpret its applications.

**Gr. 11 Math for Work and Everyday Life (MEL3E) – Overall Expectations**

Earning and Purchasing

By the end of this course, students will:

**1.** interpret information about different types of remuneration, and solve problems and make decisions involving different remuneration methods;

**2.** demonstrate an understanding of payroll deductions and their impact on purchasing power;

**3.** demonstrate an understanding of the factors and methods involved in making and justifying informed purchasing decisions.

Saving, Investing, and Borrowing

By the end of this course, students will:

**1.** describe and compare services available from financial institutions;

**2.** demonstrate an understanding of simple and compound interest, and solve problems involving related applications;

**3.** interpret information about different ways of borrowing and their associated costs, and make and justify informed borrowing decisions.

Transportation and Travel

By the end of this course, students will:

**1.** interpret information about owning and operating a vehicle, and solve problems involving the associated costs;

**2.** plan and justify a route for a trip by automobile, and solve problems involving the associated costs;

**3.** interpret information about different modes of transportation, and solve related problems.

**Gr. 12 Math for Work and Everyday Life (MEL4E) – Overall Expectations**

Reasoning with Data

By the end of this course, students will:

**1.** collect, organize, represent, and make inferences from data using a variety of tools and strategies, and describe related applications;

**2.** determine and represent probability, and identify and interpret its applications.

Personal Finance

By the end of this course, students will:

**1.** gather, interpret, and compare information about owning or renting accommodation and about the associated costs;

**2.** interpret, design, and adjust budgets for individuals and families described in case studies;

**3.** demonstrate an understanding of the process of filing a personal income tax return, and describe applications of the mathematics of personal finance.

Applications of Measurement

By the end of this course, students will:

**1.** determine and estimate measurements using the metric and imperial systems, and convert measures within and between systems;

**2.** apply measurement concepts and skills to solve problems in measurement and design, to construct scale drawings and scale models, and to budget for a household improvement;

**3.** identify and describe situations that involve proportional relationships and the possible consequences of errors in proportional reasoning, and solve problems involving proportional reasoning, arising in applications from work and everyday life.

**Gr. 12 Advanced Functions (MHF4U) – Overall Expectations**

Exponential and Logarithmic Functions

By the end of this course, students will:

**1.** demonstrate an understanding of the relationship between exponential expressions and logarithmic expressions, evaluate logarithms, and apply the laws of logarithms to simplify numeric expressions;

**2.** identify and describe some key features of the graphs of logarithmic functions, make connections among the numeric, graphical, and algebraic representations of logarithmic functions, and solve related problems graphically;

**3.** solve exponential and simple logarithmic equations in one variable algebraically, including those in problems arising from real-world applications.

Trigonometric Functions

By the end of this course, students will:

**1.** demonstrate an understanding of the meaning and application of radian measure;

**2.** make connections between trigonometric ratios and the graphical and algebraic representations of the corresponding trigonometric functions and between trigonometric functions and their reciprocals, and use these connections to solve problems;

**3.** solve problems involving trigonometric equations and prove trigonometric identities.

Polynomial and Rational Functions

By the end of this course, students will:

**1.** identify and describe some key features of polynomial functions, and make connections between the numeric, graphical, and algebraic representations of polynomial functions;

**2.** identify and describe some key features of the graphs of rational functions, and represent rational functions graphically;

**3.** solve problems involving polynomial and simple rational equations graphically and algebraically;

**4.** demonstrate an understanding of solving polynomial and simple rational inequalities.

Characteristics of Functions

By the end of this course, students will:

**1.** demonstrate an understanding of average and instantaneous rate of change, and determine, numerically and graphically, and interpret the average rate of change of a function over a given interval and the instantaneous rate of change of a function at a given point;

**2.** determine functions that result from the addition, subtraction, multiplication, and division of two functions and from the composition of two functions, describe some properties of the resulting functions, and solve related problems;

**3.** compare the characteristics of functions, and solve problems by modelling and reasoning with functions, including problems with solutions that are not accessible by standard algebraic techniques.

**Gr. 12 Calculus and Vectors (MCV4U) – Overall Expectations**

Rate of Change

By the end of this course, students will:

**1.** demonstrate an understanding of rate of change by making connections between average rate of change over an interval and instantaneous rate of change at a point, using the slopes of secants and tangents and the concept of the limit;

**2.** graph the derivatives of polynomial, sinusoidal, and exponential functions, and make connections between the numeric, graphical, and algebraic representations of a function and its derivative;

**3.** verify graphically and algebraically the rules for determining derivatives; apply these rules to determine the derivatives of polynomial, sinusoidal, exponential, rational, and radical functions, and simple combinations of functions; and solve related problems.

Derivatives and Their Applications

By the end of this course, students will:

**1.** make connections, graphically and algebraically, between the key features of a function and its first and second derivatives, and use the connections in curve sketching;

**2.** solve problems, including optimization problems, that require the use of the concepts and procedures associated with the derivative, including problems arising from real-world applications and involving the development of mathematical models.

Geometry and Algebra of Vectors

By the end of this course, students will:

**1.** demonstrate an understanding of vectors in two-space and three-space by representing them algebraically and geometrically and by recognizing their applications;

**2.** perform operations on vectors in two-space and three-space, and use the properties of these operations to solve problems, including those arising from real-world applications;

**3.** distinguish between the geometric representations of a single linear equation or a system of two linear equations in two-space and three-space, and determine different geometric configurations of lines and planes in three-space;

**4.** represent lines and planes using scalar, vector, and parametric equations, and solve problems involving distances and intersections.

**Gr. 12 Mathematics of Data Management (MDM4U) – Overall Expectations**

Counting and Probability

By the end of this course, students will:

**1.** solve problems involving the probability of an event or a combination of events for discrete sample spaces;

**2.** solve problems involving the application of permutations and combinations to determine the probability of an event.

Probability Distributions

By the end of this course, students will:

**1.** demonstrate an understanding of discrete probability distributions, represent them numerically, graphically, and algebraically, determine expected values, and solve related problems from a variety of applications;

**2.** demonstrate an understanding of continuous probability distributions, make connections to discrete probability distributions, determine standard deviations, describe key features of the normal distribution, and solve related problems from a variety of applications.

Organization of Data for Analysis

By the end of this course, students will:

**1.** demonstrate an understanding of the role of data in statistical studies and the variability inherent in data, and distinguish different types of data;

**2.** describe the characteristics of a good sample, some sampling techniques, and principles of primary data collection, and collect and organize data to solve a problem.

Statistical Analysis

By the end of this course, students will:

**1.** analyse, interpret, and draw conclusions from one-variable data using numerical and graphical summaries;

**2.** analyse, interpret, and draw conclusions from two-variable data using numerical, graphical, and algebraic summaries;

**3.** demonstrate an understanding of the applications of data management used by the media and the advertising industry and in various occupations.

Culminating Data Management Investigation

By the end of this course, students will:

**1.** design and carry out a culminating investigation\* that requires the integration and application of the knowledge and skills related to the expectations of this course;

**2.** communicate the findings of a culminating investigation and provide constructive critiques of the investigations of others.

**Gr. 12 Math for College Technology (MCT4C) – Overall Expectations**

Exponential Functions

By the end of this course, students will:

**1.** solve problems involving exponential equations graphically, including problems arising from real-world applications;

**2.** solve problems involving exponential equations algebraically using common bases and logarithms, including problems arising from real-world applications.

Polynomial Functions

By the end of this course, students will:

**1.** recognize and evaluate polynomial functions, describe key features of their graphs, and solve problems using graphs of polynomial functions;

**2.** make connections between the numeric, graphical, and algebraic representations of polynomial functions;

**3.** solve polynomial equations by factoring, make connections between functions and formulas, and solve problems involving polynomial expressions arising from a variety of applications.

Trigonometric Functions

By the end of this course, students will:

**1.** determine the values of the trigonometric ratios for angles less than 360º, and solve problems using the primary trigonometric ratios, the sine law, and the cosine law;

**2.** make connections between the numeric, graphical, and algebraic representations of sinusoidal functions;

**3.** demonstrate an understanding that sinusoidal functions can be used to model some periodic phenomena, and solve related problems, including those arising from real-world applications.

Applications of Geometry

By the end of this course, students will:

**1.** represent vectors, add and subtract vectors, and solve problems using vector models, including those arising from real-world applications;

**2.** solve problems involving two-dimensional shapes and three-dimensional figures and arising from real-world applications;

**3.** determine circle properties and solve related problems, including those arising from real-world applications.

**Gr. 12 Foundations for College Math (MAP4C) – Overall Expectations**

Mathematical Models

By the end of this course, students will:

**1.** evaluate powers with rational exponents, simplify algebraic expressions involving exponents, and solve problems involving exponential equations graphically and using common bases;

**2.** describe trends based on the interpretation of graphs, compare graphs using initial conditions and rates of change, and solve problems by modelling relationships graphically and algebraically;

**3.** make connections between formulas and linear, quadratic, and exponential relations, solve problems using formulas arising from real-world applications, and describe applications of mathematical modelling in various occupations.

Personal Finance

By the end of this course, students will:

**1.** demonstrate an understanding of annuities, including mortgages, and solve related problems using technology;

**2.** gather, interpret, and compare information about owning or renting accommodation, and solve problems involving the associated costs;

**3.** design, justify, and adjust budgets for individuals and families described in case studies, and describe applications of the mathematics of personal finance.

Geometry and Trigonometry

By the end of this course, students will:

**1.** solve problems involving measurement and geometry and arising from real-world applications;

**2.** explain the significance of optimal dimensions in real-world applications, and determine optimal dimensions of two-dimensional shapes and three-dimensional figures;

**3.** solve problems using primary trigonometric ratios of acute and obtuse angles, the sine law, and the cosine law, including problems arising from real-world applications, and describe applications of trigonometry in various occupations.

Data Management

By the end of this course, students will:

**1.** collect, analyse, and summarize two-variable data using a variety of tools and strategies, and interpret and draw conclusions from the data;

**2.** demonstrate an understanding of the applications of data management used by the media and the advertising industry and in various occupations.